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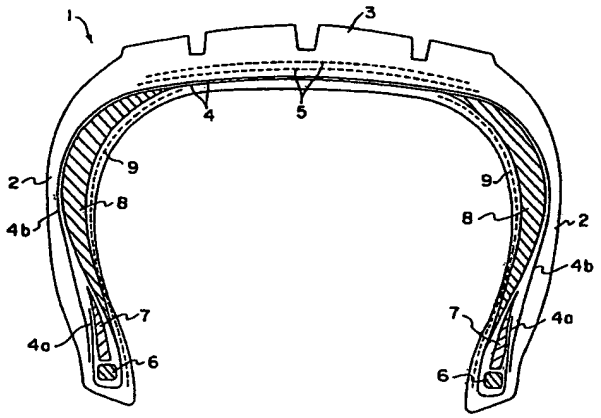
(54) Pneumatic tire for passenger cars

(57) The present invention provides a pneumatic tire for passenger cars comprising bead cores, a carcass layer, a tread portion, and side wall portions, wherein a rubber reinforcing layer having a crescent-shaped cross-section and at least one sheet of a rubber-filament fiber composite having a thickness measured under a pressure of 20 g/cm^2 of 0.05 to 2.0 mm which is formed from a rubber component and filaments having a diameter or a maximum cross-sectional dimension of 0.0001 to 0.1 mm and a length of 8 mm or more are disposed in said side wall portions and reinforcing cords of carcass plies are made of an aliphatic polyamide fiber having a melting point of 250°C or higher. Deterioration of adhesion in carcass ply does not take place during use, particularly during use in a run-flat condition, and the pneumatic tire shows excellent durability.

FIG. 1



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[0011] It is preferable that the filament fiber in the rubber-filament fiber composite is a fiber selected from the group consisting of aromatic polyamide fiber, rayon fiber, polyethylene naphthalate fiber, polyimide fiber, carbon fiber, glass fiber and steel wire, that the filament fiber in the rubber-filament fiber composite has a diameter or a maximum cross-sectional dimension of 0.0001 to 0.005 mm and a length of 10 mm or more; that the content of the filament fiber in said rubber-filament fiber composite is 4 to 50% by weight, that said rubber-filament fiber composite is formed from a rubber and a nonwoven fabric having a weight per area of 10 to 300 g/m^2, that said nonwoven fabric has a thickness of 0.1 to 0.5 mm and that said reinforcing cord of carcass ply is made of nylon 66 fiber or nylon 46 fiber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 shows a schematic cross sectional view of an example of the pneumatic safe tire of the present invention.
Fig. 2 shows a schematic cross sectional view of another example of the pneumatic safe tire of the present invention.
Fig. 3 shows schematic presentations of the structures of a side portion (a carcass portion) of the pneumatic safe tire used as an example of the present invention and as a comparative example.
Fig. 4 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 5 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 6 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 7 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 8 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 9 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 10 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 11 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 12 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 13 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 14 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 15 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.
Fig. 16 shows a schematic presentation of the structure of a side portion (a carcass portion) of the pneumatic safe tire used in another example of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The reinforcing cord of the carcass ply of the pneumatic tire for passenger cars of the present invention is made of an aliphatic polyamide fiber having a melting point of 250°C or higher as measured by DSC. By the use of this fiber, strong adhesion between rubber parts and the fiber can be obtained even at high temperatures and deterioration of the adhesion in carcass ply can be prevented.

[0014] A stabilizer such as a stabilizer comprising a copper salt and an antioxidant may be added to the polyamide fiber in order to provide the fiber with resistance to heat, light, and oxygen.

[0015] As the aliphatic polyamide fiber used for the reinforcing cord of the carcass ply of the pneumatic tire for passenger cars of the present invention, nylon 66 fiber or nylon 46 fiber is preferable in view of their adhesive properties at a high temperature.

[0016] When the melting point of the reinforcing cord of the carcass ply as measured by DSC is lower than 250°C, durability when used in a run-flat condition is inferior because it becomes difficult to maintain the shape of the tire at a high temperature.

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cient, a dipping heat set treatment may be applied to the filament fiber in a similar manner to that used for enhancement of the adhesion between fiber cords for tires and rubber.

[0028] It is preferable that the rubber reinforcing layer having a crescent-shaped cross-section is disposed at the inner side of the carcass ply.

[0029] The rubber component used for the carcass ply, the rubber-filament fiber composite, and the rubber reinforcing layer is not particularly limited. Examples of the rubber component include natural rubber (NR), butadiene rubber (BR), styrene-butadiene rubber (SBR), and isoprene rubber (IR).

[0030] As for the physical properties of the rubber composition used for the composite, it is preferable that the tensile stress at 50% elongation (M_{50}) is 2 to 9 MPa and the tensile stress at 100% elongation (M_{100}) is 4 to 15 MPa.

[0031] The carcass ply used in the present invention can be prepared from the aliphatic polyamide cord and the rubber composition in accordance with a conventional process. The carcass ply thus prepared is applied to prepare a green tire, which is then vulcanized in a mold.

[0032] In the pneumatic tire of the present invention, the structure of the carcass, the size of the nonwoven-fabric and the position where the nonwoven fabric is disposed are not particularly limited. For example, the nonwoven-fabric can be disposed at the positions shown in Figs. .

[0033] The reference numbers in the figures have the following meanings:

1: a pneumatic tire
2: a side wall portion
3: a tread portion
4: a carcass layer
4a: a turned up carcass ply
4b: a down carcass ply
5: a belt portion
6: a bead core
7: a bead filler
8: a rubber reinforcing layer
9: a rubber-filament fiber composite
10: a belt reinforcing layer
11: a belt reinforcing layer

[0034] A structure of the pneumatic tire in accordance with the present invention will be described below with reference to the drawings.

[0035] An example of a schematic cross sectional view of the pneumatic safe tire of the present invention is show in Fig 1.

[0036] Both ends of a turned up carcass ply 4a using a layer of Nylon 66 in which a cord direction is directed to a radial direction of the tire 1 are turned around a pair of right and left bead core 6 and bead fillers 7. Two layers of steel belts 5 are arranged above the carcass plies 4 in a radial direction of the tire, and a tread rubber 3 is arranged in a tire road contact surface portion provided above the steel belts 5. Further, side wall rubbers 2 are arranged on the carcass layer of both sides of the tread rubber 3. In Fig. 2, belt reinforcing layers 10 and 11 are arranged outside the belt layer 5.

[0037] An arrangement of the carcass portion in the tire side portion of the pneumatic tire in the present invention is exemplified in structures I, II, III, IV and V (in Figs. 3, 4, 5, 6, and 7).

[0038] In the structures I and II, in addition to the two turned up carcass ply 4a using Nylon 66 cords, a reinforcing rubber layer 8 having a crescent cross section (for example, a maximum thickness 13 mm and a Shore hardness 80 degrees) is arranged inside the carcass ply 4a having a 3P carcass structure in which a sheet of down carcass 4b is arranged on the most front layer. In the structures III and IV, a reinforcing rubber layer 8 having a crescent cross section is arranged inside the carcass ply 4 having a 2P carcass structure in which an end of the carcass ply 4a using a sheet of steel cord is turned up to the tread portion enveloped structure. In the structure V, the reinforcing rubber layer 8 is arranged inside the carcass ply 4 having a 1P carcass portion in which a turned up ply forms an enveloped structure.

[0039] Further in structures II, IV and V, at least one sheet of rubber-filament fiber composite 9 having a specific size and composition is arranged inside the carcass ply 4a in the side wall portion.

EXAMPLES

[0040] The present invention is described more specifically with reference to the following examples. However, the present invention is not limited to the examples.

[0041] The melting point of the fiber was measured by a differential scanning calorimeter with a sample of about 5 mg at the speed of temperature increase of 10°C/min using a DSC manufactured by the DU PONT Company. The melting

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ament fiber, a rubber-filament fiber composite was prepared by using a Banbury mixer. When a nonwoven fabric was used as the filament fiber, an unvulcanized rubber composition in a sheet form was pressed to both faces of the nonwoven fabric by a press at 70°C.

[0050] The rubber composition used was the same as that used for the reinforcing rubber layer.

[0051] The following four types of carcass structure were examined:

Structure I: A 3P structure having two turned-up carcass plies and one down carcass ply at an outer side of the turned-up plies.
Structure II: A 3P structure having two turned-up carcass plies, one down carcass ply at an outer side of the turned-up plies and a rubber-filament fiber composite disposed at an inner side of a rubber reinforcing layer having a crescent-shaped cross-section.
Structure III: A 2P structure having one turned-up carcass ply and one carcass ply whose end is turned up to a tread portion.
Structure IV: A 2P structure having one turned-up carcass ply, one carcass ply whose end is turned up to a tread portion, and a rubber-filament fiber composite disposed at an inner side of a rubber reinforcing layer having a crescent-shaped cross-section.
Structure V: A 1P structure having carcass ply whose end is turned up to a tread portion, and a rubber-filament fiber composite disposed at an inner side of a rubber reinforcing layer having a crescent-shaped cross-section.

[0052] For the reinforcing cord of the carcass ply, nylon 66 fiber (melting point: 260°C) or nylon 46 fiber (melting point: 290°C) was used.

[0053] The structure of the tires and the results of the evaluation of the properties of the tires are shown in Table 2.

Table 2 - 1

	Comparative Example 1	Example 1	Example 2	Example 3
Reinforcing component				
reinforcing rubber layer	present	present	present	present
composite				
nonwoven fabric	absent	present	present	absent
filament fiber	absent	absent	absent	present
fiber	-	aramide	aramide	aramide
length of fiber (mm)	-	50	50	50
diameter of fiber (mm)	-	0.02	0.02	0.02
weight per area (g/m^2)	-	50	50	-
Carcass ply cord				
material	nylon 66	nylon 66	nylon 46	nylon 66
structure	1400dtex/2	1400dtex/2	1400dtex/2	1400dtex/2
tensile strength (N/cord)	230	230	224	230
elongation at break (%)	20.0	20.0	15.0	20.0
structure	3P	3P	3P	3P
Tire structure	I	II	II	II
Durability in a run-flat condition (index)*1	100	125	130	125
Durability in an inflated condition	good	good	good	good

*1.: Comparative Example 1 is the control run for Examples 1 to 3.

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3. A pneumatic tire according to Claim 1, wherein said filament fiber in said rubber-filament fiber composite has a diameter or a maximum cross-sectional dimension of 0.0001 to 0.005 mm and a length of 10 mm or more.

4. A pneumatic tire according to Claim 1, wherein the content of the filament fiber in said rubber-filament fiber composite is 4 to 50% by weight.

5. A pneumatic tire according to Claim 1, wherein said rubber-filament fiber composite is formed from a rubber and a nonwoven fabric having a weight per area of 10 to 300 g/m^2.

6. A pneumatic tire according to Claim 5, wherein said nonwoven fabric has a thickness measured under a pressure of 20 g/cm^2 of 0.1 to 0.5 mm.

7. A pneumatic tire according to Claim 1, wherein said reinforcing cords of carcass plies are made of at least one fiber selected from the group consisting of nylon 66 fiber and nylon 46 fiber.

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FIG. 2

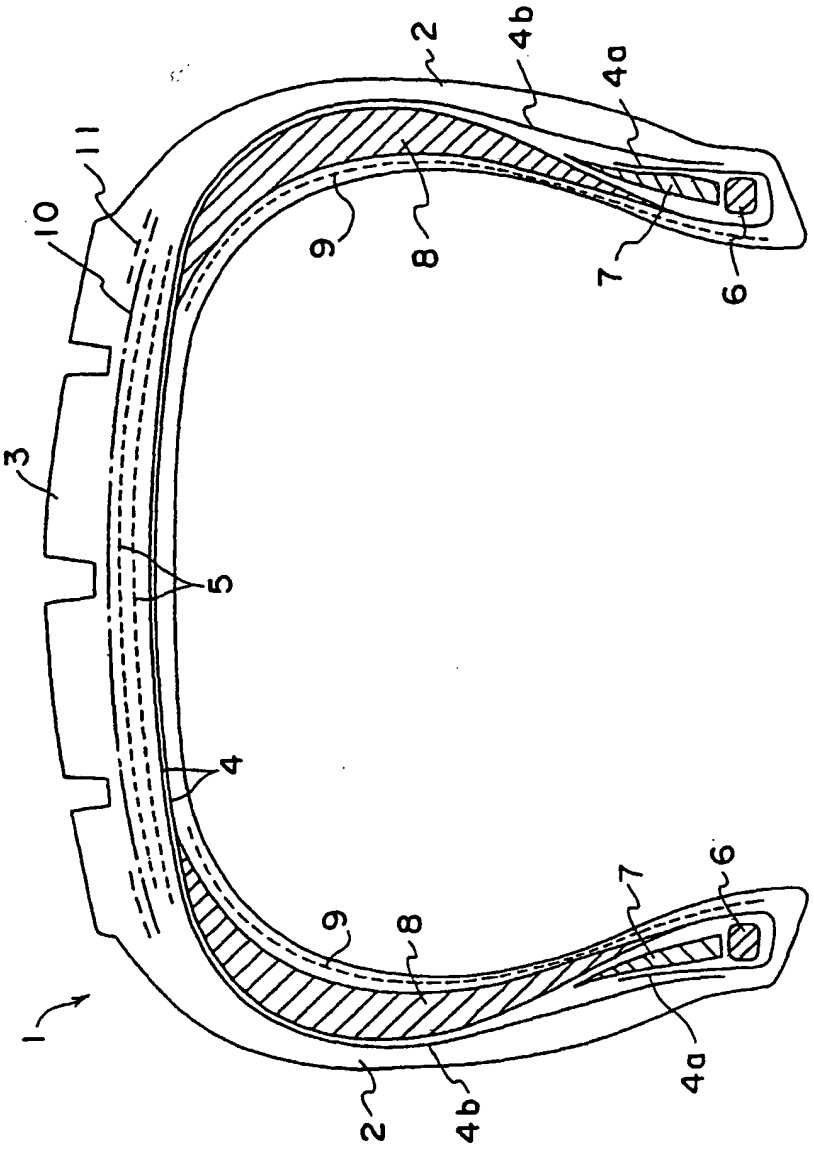

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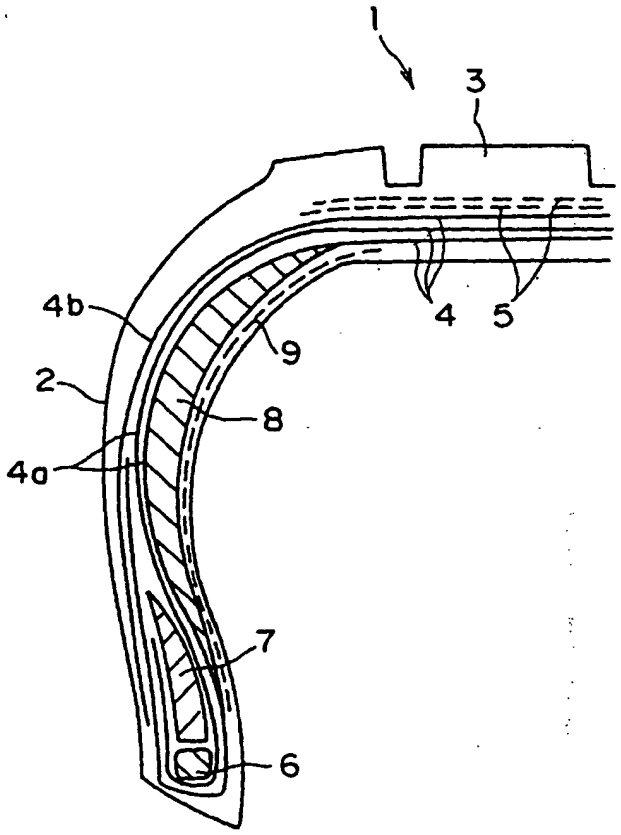
FIG. 4



STRUCTURE II

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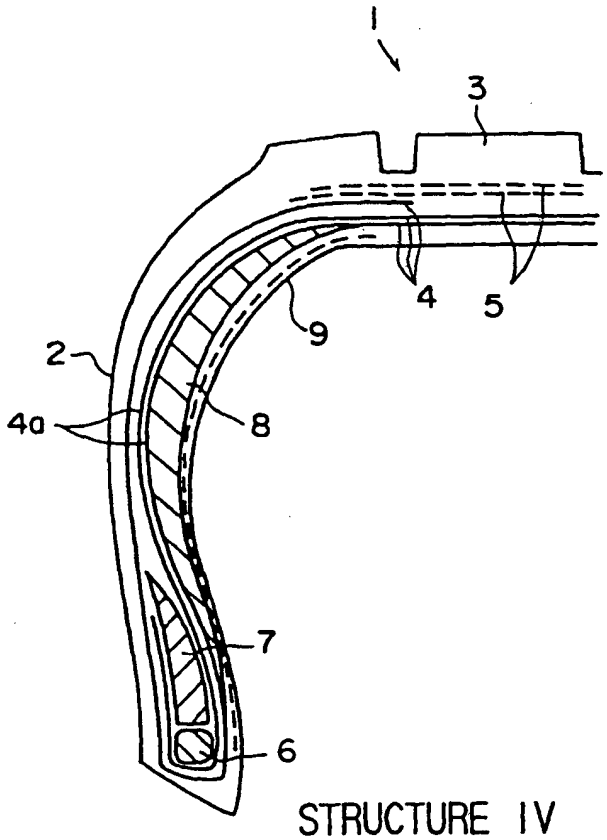
FIG. 6



STRUCTURE IV

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FIG. 8

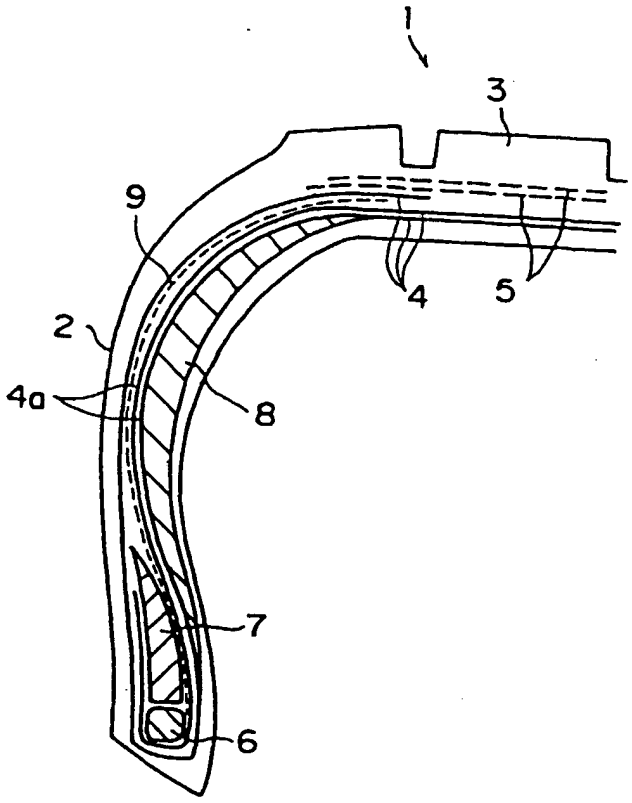

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FIG. 10

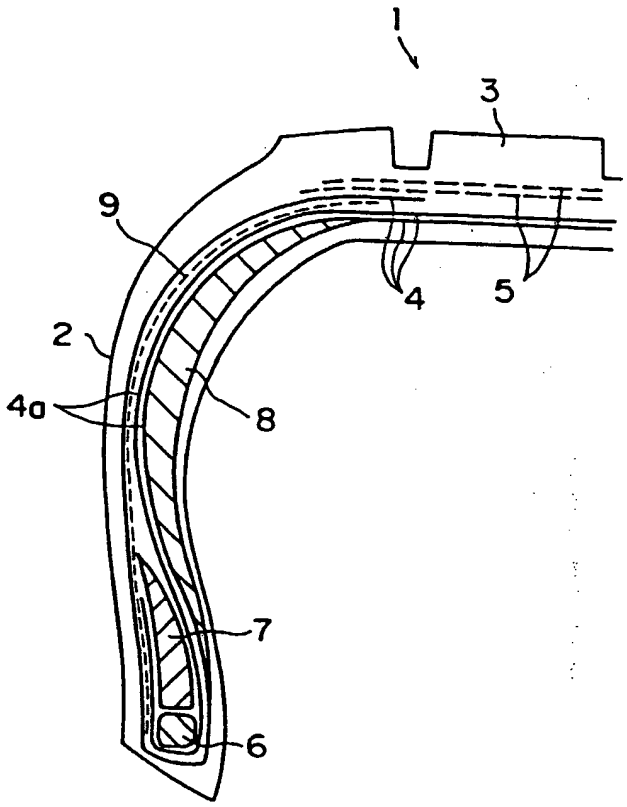

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FIG. 12

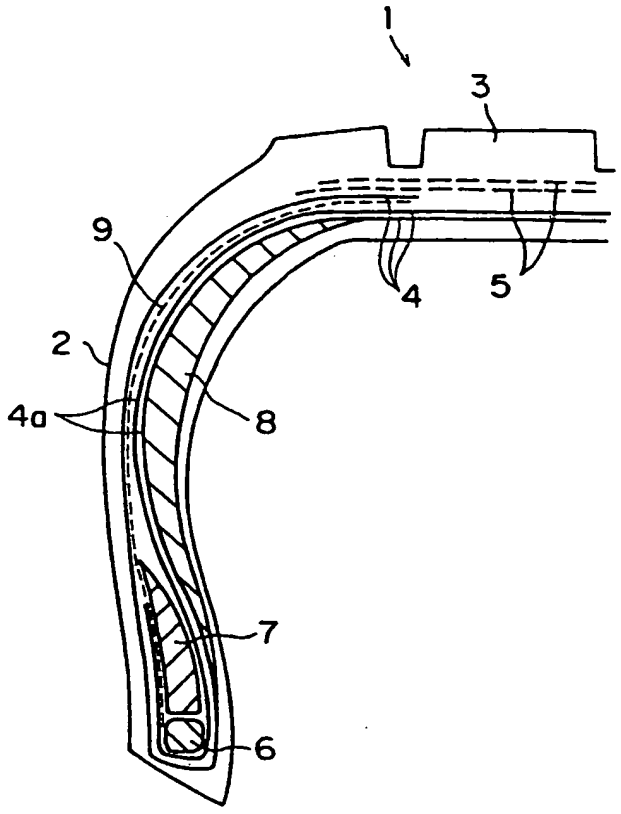

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FIG. 14

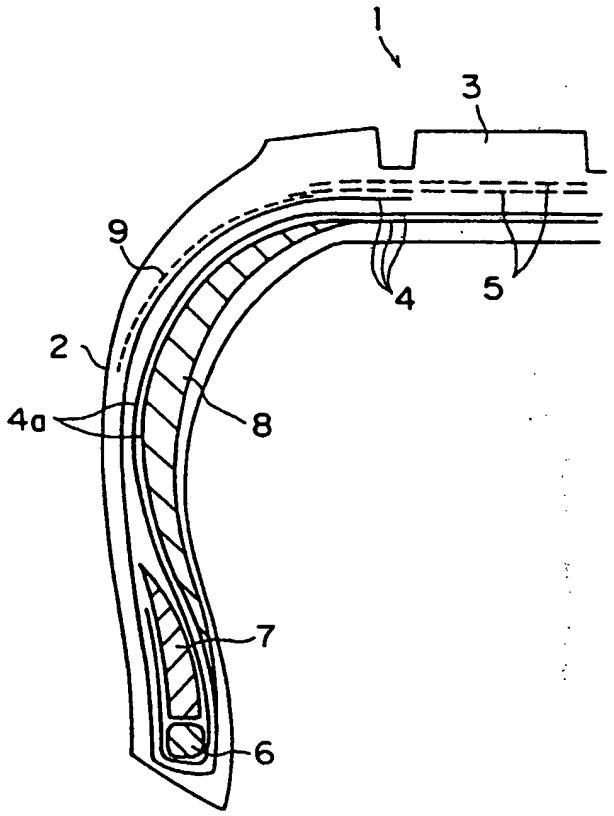

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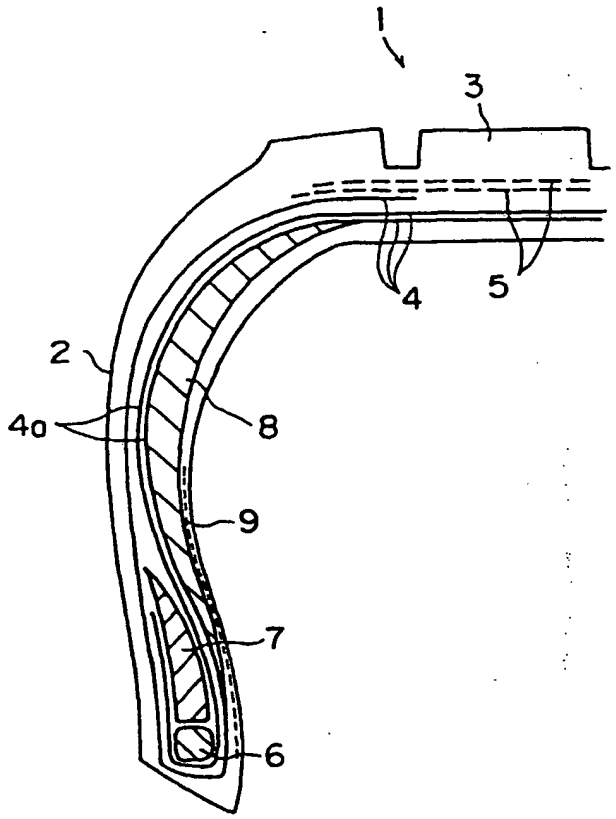
FIG. 16



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(54) Pneumatic tire for passenger cars

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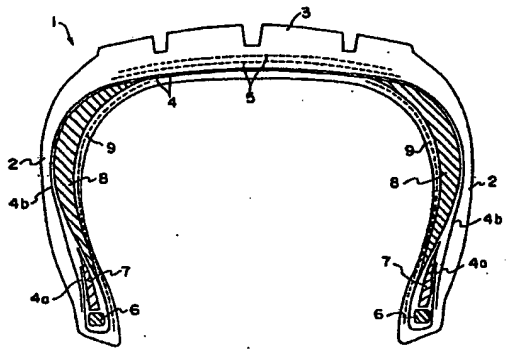
FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 98 31 0603

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	PATENT ABSTRACTS OF JAPAN vol. 097, no. 007, 31 July 1997 (1997-07-31) & JP 09 058229 A (YOKOHAMA RUBBER CO LTD:THE), 4 March 1997 (1997-03-04) * abstract * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 September 1999	Baradat, J-L

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP 53014801 B	20-05-1978
JP 09058229 A	04-03-1997	NONE	

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